High Efficiency, High Temperature Foam Core Heat Exchanger for Fission Surface Power Systems, Phase II

Completed Technology Project (2009 - 2011)

Project Introduction

Fission-based power systems with power levels of 30 to ≥100 kWe will be needed for planetary surface bases. Development of high temperature, high efficiency heat exchangers is critical for next-generation nuclear power and space propulsion systems. In Phase I, Ultramet and Sandia National Laboratories demonstrated the feasibility of using high surface area foam core heat exchanger technology to substantially improve the power conversion efficiency of liquid metal-to-gas high temperature heat exchangers for fission surface power systems. Preliminary design and modeling suggested a substantial improvement in the efficiency of a liquid lithium-to-helium component relative to conventional plate-fin heat exchangers, and hardware fabrication and testing demonstrated the manufacturability, performance, and simplicity of the foam-based design. Open-cell foam is a natural coolant channel that does not require extensive, expensive machining of intricate coolant passages and eliminates the need for braze-bonding or welding of numerous individual sections. Initial testing showed the ability of textured, vapor-deposited lithium-compatible coatings to be uniformly wetted by liquid lithium at low temperature. The technology has the potential to best minimize the temperature difference between the maximum lithium reactor coolant and helium working fluid temperatures, as well as to reduce system mass and volume through the use of high surface area, low density open-cell foam, and increase safety and reliability by minimizing the number of piece parts and associated joints. In Phase II, Ultramet will team with Sandia to expand on the Phase I success by performing comprehensive design and stress analysis, determining physical properties, and establishing performance through high temperature (1000 K) thermal response and flow testing of coaxial heat exchangers using the Helium Flow Loop and Liquid Metal Integrated Test System at Sandia's Plasma Materials Test Facility.

High Efficiency, High Temperature Foam Core Heat Exchanger for Fission Surface Power Systems, Phase II

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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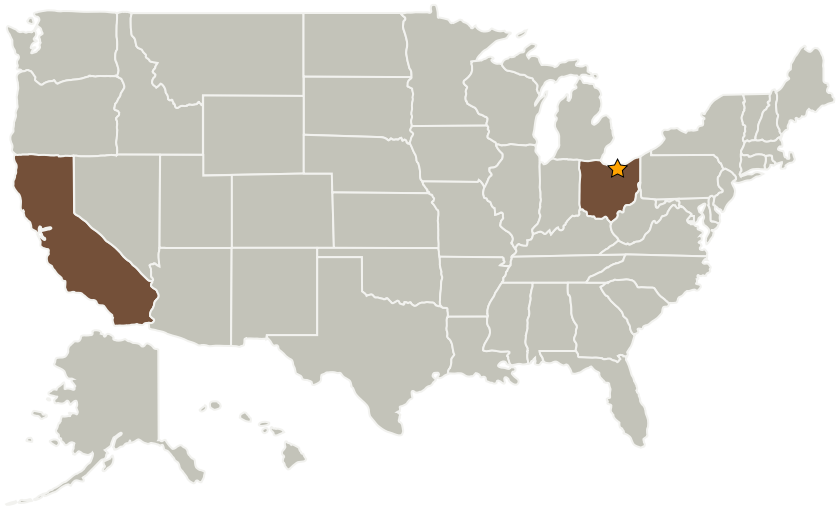
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Ultramet	Supporting Organization	Industry	Pacoima, California

Primary U.S. Work Locations	
California	Ohio

Project Transitions

January 2009: Project Start

September 2011: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.1 Heat Acquisition